

with the point directed toward the mud, in which it lodges ready for almost immediate development. Dr. I. M. Johnston, in his interest in this species, observed the fall of the fruit over a period of time. In his very interesting and enlightening treatment of the species in *Sargentia* 8: 207. 1949, he states that the fruit always drops with the heavy portion downward. He further states, however, that once in the water the buoyant fruit floats with the beak end downward.

The single seed, when mature, is very simple, and consists of two huge obcordate cotyledons, each measuring as much as 7 cm. across, a pointed radicle which extends into the beak of the fruit, and a curved plumule, often with two or three miniature leaves partially developed. No endosperm is present. The genus *Archytaea* is also distinctive because of the absence of endosperm.

Another character considered by some as at variance with other genera of the Theaceae is the number of stamens. One generally associates with this family a large number of stamens. In *Pelliciera* the number has been reduced to five. This seems a far cry from the multitude found in *Ternstroemia*, *Gordonia*, *Stewartia*, *Archytaea*, and *Ploiarium*. However, some genera in the family do present a low number of stamens. In these genera considerable variation may be found within any given genus, but no species has a number as low as five! A record of some of these is as follows: *Freziera* 15-30; *Adinandra* 15-60; and *Visnea* 10-21.

On the other hand, characters often seemingly of little importance show that a close relationship exists between *Pelliciera* and other genera of the Theaceae. The leaf-base, as mentioned elsewhere in this paper, is totally decurrent and very much like that found in *Archytaea*, *Ploiarium*, and *Bonnetia*. In most of the other genera of the family the leaf-base is often decurrent, but in varying degrees. The asymmetrical shape of the leaf, although far from universal, is found among species of several genera. In *Laplacea fruticosa* (Schrader) Kobuski an almost identical pattern of shape and denticulation may be found. In both instances the blade is asymmetrical and glandular denticulations are found along the upper half of the larger side of the leaf. The glandular denticulations in *Pelliciera* are more pustular in character than in *Laplacea*, but, as in all other members of the family when found they slough off or are broken off at maturity.

The long tapering ovary and style ending in a punctate stigma is typical of the family. It is obvious through dissections that reduction in the number of cells has taken place, probably a reduction from five to two cells. Dissections were made of material from both Colombia and Panama. Planchon and Triana recorded in their original manuscript five cells for the ovary (Colombia), based, I feel, solely on the fact that the floral parts were consistently in fives. Bentham and Hooker queried the five-celled ovary and reported it as two-celled. In some of my dissections only a single cell was found in the ovary, abortion of the second cell having already occurred. In other instances the second cell was

present but undeveloped and without an ovule. No ovary with five cells was found!

The ridges on the ovary have been reported as ten in number with the filaments lying in alternate grooves. The number of grooves or ridges is not always ten but close to that number. The filaments which lie pressed within the grooves are not adnate to the ovary but appear so, with the ridges pressing inward and over them during development. The filaments can be drawn from the grooves when the ovary is boiled up. I think I am right in assuming that in fresh material the filaments could likewise be easily separated from the ovary.

The ovary has been reported as pendulous and depicted as attached at the apex. My dissections showed clearly that the ovule is campylo-tropous, the placenta axial, and the attachment slightly below the apex of the ovule.

The developed seed, although very large, has a buff-colored mealy coating in indefinite quantity. Occasionally this coating may be lacking. This is the typical coating of many seeds in the genus *Ternstroemia*.

Pelliciera rhizophorae Triana & Planchon in Ann. Sci. Nat. sér. 4, 17: 381. 1862, as "*Pelliceria rhizophorae*."—Hemsley, Biol. Centr.-Amer. 1: 97, t. 8. 1879.—Szyszyłowicz in Nat. Pflanzenfam. III. 6: 192, fig. 96. 1893.—Pittier, Prim. Fl. Costaricensis 2: 38. 1898.—Howe in Jour. New York Bot. Gard. 12: 61-72, figs. 16-23. 1911.—Melchior in Nat. Pflanzenfam. ed. 2, 21: 154, fig. 67. 1925.—Standley in Contrib. U. S. Nat. Herb. 27: (Fl. Panama Canal Zone 267). 1928; in Bot. Ser., Field Mus. Nat. Hist. 18: (Fl. Costa Rica 702). 1937.—Little in Caribbean Forester 9: 258. 1948.—Johnston in Sargentia 8: 207. 1949.

Pelliceria rhizophorae Triana & Planchon var. β . *Benthamii* Triana & Planchon in Ann. Sci. Nat. sér. 4, 17: 381. 1862.

Tree 6-15 m. high with a single trunk and elongated crown, buttressed at the base, the bark gray, roughened by conspicuous circular raised light brown lenticels 2-3 mm. in diameter; branches open, the branchlets glabrous, roughened by sharply defined leaf scars and becoming somewhat geniculate near the apex from the large protruding flower scars. Leaves glabrous, usually closely disposed at the ends of the branchlets in a seeming rosette, occasionally along the stem, sessile, coriaceous, 10-15 cm. long, 2-4 cm. wide, asymmetrical, one half appearing constantly as half an ellipse with the widest part near or below the middle, the other half wider with the widest portion usually above the middle, acute at the apex, tapering to a wide decurrent base, the midrib and veins quite inconspicuous, the margin usually entire along the smaller half of the leaf, glandular denticulate along the upper half of the wider side of the leaf when young, later apparently entire. Flowers large, showy, solitary, axillary, although seemingly terminal, sessile; the bud enveloped by two large glabrous foliaceous bracts ca. 5 cm. long and 1 cm. wide, rose-colored, coral-red or crimson; sepals 5, glabrous, imbricate, unequal,

broadly ovate to ovate, 2–2.5 cm. long, ca. 1–1.5 cm. wide, acute at the apex, concave, the median portion thickened by glandular punctations, otherwise membranaceous, the margin entire. Petals 5, free, equal or subequal, lanceolate to ligulate-lanceolate, 5–7 cm. long, ca. 1.5 cm. at the base, 0.4–0.5 cm. near the apex, blunt-pointed, usually white, occasionally pink, hyaline for the most part, thickened in the center, increasingly so in both depth and width toward the base, the margin entire. Stamens 5, 4–5 cm. long, the filaments tenuous, ca. 3.5 mm. long, closely appressed but not adnate within the longitudinal grooves of the ovary for most of their length, the anthers linear, as much as 3 cm. long, sagittate at the base, the narrow connective projected into a point at the apex. Pistil conical cylindrical, 6.5–7 cm. long, divided almost equally into a grooved ovary and a smooth style, the ovary ca. 5 mm. diameter somewhat flattened with the outer surface corrugated into approximately 10 grooves, the filaments resting in alternate grooves, 2-celled with a single large ovule in each cell, occasionally with only one cell ovulated or a single cell by abortion, the style smooth, the stigma punctate, 2-parted. Fruit napiform in lateral outline, coriaceous-fungose, 7–10 cm. long (including the attenuated beak which measures one-third to one-half the entire length), ca. 8 cm. broad and 3–4 cm. thick, reddish brown, irregularly longitudinal-furrowed, with rows of lenticel-like waxy pustules becoming pulverulent. Seed solitary consisting almost wholly of two large fleshy obcordate cotyledons as much as 6 cm. long and 7 cm. across, with a firm pointed radicle projecting into the beak, and a large curved plumule; the endosperm is lacking.

DISTRIBUTION: Mangrove swamps along Pacific coast, and islands of Costa Rica, Panama, Colombia, and Ecuador.

COSTA RICA: Puntarenes: Punta Mala, dans les terrains inondés par la mer, *A. Tonduz* 6723 (US), March 1892 (tree).—Daquis Delta, dans les terrains inondés par la mer, *A. Tonduz* 6773 (US), March 1892 (tree).—Sandy and muddy beaches, *P. Biolley* 2026 *H. P.* (US), January 1907.—Sandy beaches, *P. Biolley* 17405 (G), January 1909.—Puerto Jiménez de Osa, *A. M. Brenes* 696 (Ch), April 14, 1930.—Precise locality lacking, *M. Querós* 995 (Ch), October 7, 1941.

PANAMA: Canal Zone: Banks of Rio Grande, growing in mud, *R. E. Woodson*, *P. H. Allen* & *R. J. Seibert* 762 (AA, Mo, NY), June 21, 1938 (shrubby tree 3–4 m.; calyx red; petals white).—Bella Vista, mangrove swamp, *F. M. Salvoza* 1004 (AA), September 10, 1929 (tree 2–3 m.; fruit brownish).—Balboa, on mud of estuary, *M. A. Howe* *s. n.* (NY), December 18, 1909.—Between Corozal and Ancon, swamp, alt. 10–30 m., *H. Pittier* 2644 (G, NY, US), February 2, 1911 (small tree 5 m.; flowers pinkish white). Prov. Panama: Rio La Maestra, mangrove swamps, alt. 0–25 m., *P. H. Allen* 32 (AA, Ch, Mo), December 4, 1936 (tree 5 m.; flowers white).—Precise locality lacking, *Bro. Heriberto* 210 (US), November 3, 1921. San Jose Island: Perlas Archipelago: Gulf of Panama (ca. 55 miles south-southeast of Balboa): mangrove swamp back of Main Beach, *I. M. Johnston* 332 (AA), 1124 (AA), October 30, 1944 and January 12, 1946 (tree 40 ft., the trunk conical at the base; flowers white; fruit husk brown, juicy but firm).

COLOMBIA: Dept. El Valle: Buenaventura Bay: mangrove thicket along bay, alt. 0-5 m., *E. P. Killip* 5222 (AA, NY, US), May 7-9, 1922 (tree 25 ft.; flowers white).—Mangrove swamp, *E. P. Killip* 34961 (US), April 13, 1939 (tree 8-10 m.; petals white).—Punta Arenas, north shore of Buenaventura Bay in mangrove swamp, sea level, *E. P. Killip & J. Cuatrecasas* 38624 (AA, US), June 2, 1944 (low shrub to tree 10 m.; calyx and petals white).

ECUADOR: Prov. Esmeraldas: Borbón, along Rio Santiago, near La Tola, mangrove swamp at water's edge, *E. L. Little* 6423 (US), May 4, 1943 (large tree to 25 m. high and 60 cm. diameter; large 1-seeded pod to 10 cm.).

This water-dispersed species is endemic to the small area of the Pacific coast of Costa Rica, Panama, Colombia, and Ecuador. From the collections studied, it seems that the most varied distribution is found in Panama, where it has been collected in the Canal Zone, Prov. of Panama, and San Jose Island. From Costa Rica six collections were studied, and all were from the beaches of Puntarenas. This appears to be the northernmost limit in the range. In Colombia only three collections were studied. These were from Buenaventura Bay and all three were collected by Killip over a period of twenty-two years. Up until 1943 the abovementioned area comprised the known distribution. In 1943 Little added to the range with his collection 6423 from the Province of Esmeraldas in the extreme northwest of Ecuador, and Johnston made two collections from San Jose Island. In Costa Rica the plant is known by the vernacular name of *mangle piñuela*, in Ecuador as *piñuela*, and in Panama as *palo de sal*.

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THE GENUS PITTOSPORUM IN THE SINO-INDIAN REGION

With four text-figures

MARI GOWDA

INTRODUCTION

THE GENUS *Pittosporum*, established by Banks on material collected in New Zealand, was published in Gaertner's *Fructibus et Seminibus Plantarum* 1: 286, *t.* 59, *fig.* 7 (1788). The name is derived from the Greek *pitta*, pitch, and *sporos*, seed, alluding to the sticky pulp enveloping the seeds. In geographic distribution the plant is confined to the Old World, where it is widely spread in the tropics and the temperate areas of both the southern and the northern hemispheres. It is very abundant in Australia. Most of the species are exceedingly variable and singularly lacking in the obvious characters which are useful for quickly identifying plants. In most regions where *Pittosporum* is well represented it is recognized by systematists as a confusing and difficult genus.

This paper presents the results of an extensive study of *Pittosporum* in Asia, where the genus has had an important evolutionary center and now has its most northerly extension. The area includes not only continental Asia but also floristically similar Japan, the Bonin Islands, Ryu-Kyu, and Formosa. Most of the *Pittospora* in this area are endemic. It was not until the latter part of the 19th century that China was open to exploration by the western countries. With ample material, the product of recent explorations, I have recognized about 30 species from China.

HISTORY

The first member of the genus *Pittosporum* known to European botanists was collected by Kaempfer during his sojourn in Japan, 1690–1692. This was later illustrated and described as *Tobira* by him in *Amoenitatum Exoticarum* 5: 796, *t.* 797 (1712). No reference to this plant appears in Linnaeus' *Species Plantarum* (1753); but in Thunberg's *Flora Japonica* 99 (1784) it is described as *Evonymus Tobira*. It appeared as *Pittosporum* for the first time in Aiton's *Hortus Kewensis* ed. 2, 2: 27 (1811), where it is listed with four other species, all with brief descriptions. *Pittosporum pauciflorum* was described by Hooker & Arnott in *Botany, Beechey's Voyage* 168, *t.* 32 (1833) from the Beechey's collection of Chinese plants. In 1846 *P. glabratum*, a plant introduced to England from China, was described by Lindley in *Journal, Horticultural Society of London* 1: 230. These species are of historic importance because China

had remained a closed country for European botanical exploration until the year 1842. Previous to that time the known species of *Pittosporum* from China were all from in and around Macao and Canton. In 1886 only four species were listed by Forbes & Hemsley in *Index Florae Sinensis* 1: 58. As plant exploration proceeded, it became increasingly evident that the genus had an important center in southern and southeastern China. Seven species and one variety were recorded by Rehder in *Plantae Wilsonianae* 3: 326–330 (1917). The impetus given to botanical exploration by the opening of China to western botanists during the latter part of the 19th century and in the present one is manifest in the extensive collections distributed into various herbaria. Many of the new species of *Pittosporum* have been described during this period and reported in numerous botanical periodicals. Since the references are listed in the text with the descriptions of the species and the subsequent discussions, it seems quite unnecessary to review them here or to list them in the form of a bibliography at the end of this work.

Most of the species in India were known by the middle of the 19th century. Roxburgh described the earliest one in *Flora Indica* 2: 39 (1824) as *Celastrus*. Wight was the first botanist in that country to recognize the genus *Pittosporum*; he described three species in his *Prodromus* 1: 153–154 (1834). By the time that Hooker prepared his great work for India nine species were known, and these were briefly described by him in the *Flora of British India* 1: 198–200 (1872). As far as the Indian *Pittospora* are concerned, this is still the most valuable reference.

Among the treatments of the genus as a whole, a few are of importance to our area. De Candolle's *Prodromus* 1: 346 (1894) included eleven species, three of which occurred in the area under study. Putterlick, *Synopsis Pittosporum* (1839), reviewed and enumerated 36 species, of which nine were found in our area. Pritzel's treatment of the family Pittosporaceae in Engler and Prantl, *Die Natürlichen Pflanzenfamilien*, ed. 2, 18a: 265–286 (1930), dealt mostly with the general aspects of the genus and gave a synopsis of all the species occurring in all the regions. It is, indeed, the most important item in the extensive bibliography of the genus.

MATERIALS

The main source of materials on which this study is based is the vast collections of *Pittosporum* from China and India which have accumulated in the herbarium of the Arnold Arboretum. These have been supplemented by loans from the Gray Herbarium, from the New York Botanical Garden, and from the Sibpur Botanic Garden, Calcutta, India. Several type specimens have been obtained from the herbarium of the Royal Botanic Garden, Kew, England. In citing specimens from the above herbaria the following symbols have been employed: (A) = Arnold Arboretum; (GH) = Gray Herbarium; (NY) = New York Botanical Garden; (C) = Sibpur Botanic Garden; and (K) = Kew.

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MORPHOLOGY AND TAXONOMIC CRITERIA

General habit: The Asiatic species are small trees or shrubs. They are mostly upright, but a few, such as *P. heterophyllum* var. *sessile* and *P. saxicola*, are low and spreading. Young shoots in several species and especially in *P. eriocarpum*, *P. ferrugineum*, and *P. formosanum*, are covered with dense induments but later become glabrescent; most species, however, are glabrous even when young. In herbarium specimens the twigs are usually brown to brownish grey and commonly speckled with small whitish lenticels. In *P. parvifolium*, however, the lenticels become very prominent collar-like slits on the bark. Similar collar-like lenticels are prominent on the pedicels of the fruit in *P. gagnepainianum*. Leaf-scars vary in size according to the stoutness of the petioles. In shape they are roundish to reniform and often more or less triangular. All show the marks of three vascular bundles. These features are of minor value and of little use in the classification of the Asiatic species of the genus. Branching usually is either simple or verticillate. The behavior of the leading shoot may be described as follows:

1. Vegetative in the first year.
 - a. Producing terminal leafy inflorescences the second year and also a new leading vegetative shoot or shoots from the lower axils;
or
 - b. Producing leafless pseudoterminal inflorescences the second year from the buds congested at the apex, and also a new leading vegetative shoot or shoots.